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Resilient crop-livestock systems

LEISA INDIA

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Integrated farming systems provide nutritional and livelihood security for small farmers.

(Photo: S Jayaraj for AMEF)

The AgriCultures Network

LEISA India is a member of the global Agricultures Network. Seven organisations that provide information on small-scale, sustainable agriculture worldwide, and that publish:

Farming Matters (in English)

LEISA revista de agroecología (Latin America)

LEISA India (in English, Kannada, Tamil, Hindi, Telugu, Oriya, Marathi and Punjabi)

AGRIDAPE (West Africa, in French)

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www.leisaindia.org

Dear Readers

Small farmers deal with meagre means and resources. Further they are caught in fragile eco systems vulnerable to climate variances. They constantly grapple with climate and markets – both unpredictable in their own way. Being pushed into growing only cash crops, often, farmer's own family's well being in terms of access to balanced nutrition is given a low priority. It is always a challenge to improve small farmer livelihoods, enabling them to get better nutrition and incomes.

It is well recognised worldwide that production efficiencies based on linear models are inappropriate for agroecological farms. Agroecological models are fundamentally interconnected in terms of resource flows between components. However, we need to recognise that it is farmer who is taking the risk – constantly looking at his farm in terms of investments made and the assured returns.

An attempt has been made in this issue to illustrate how farmers could create useful linkages between components like crops and livestock, practically, to optimise resource use and get improved incomes. Also, showcased is an example of how sustainable relationships are created between different communities – pastoralists and farmers.

Hope these examples inspire farming communities to try out and development agencies to support further such initiatives. As readers and authors, you have been the driving force in helping us promote alternative approaches in a deeply positive and practical way. Please continue your exemplary support in the future too.

Wishing all our readers a very Happy New Year!

The Editors

LEISA is about Low-External-Input and Sustainable Agriculture. It is about the technical and social options open to farmers who seek to improve productivity and income in an ecologically sound way. LEISA is about the optimal use of local resources and natural processes and, if necessary, the safe and efficient use of external inputs. It is about the empowerment of male and female farmers and the communities who seek to build their future on the bases of their own knowledge, skills, values, culture and institutions. LEISA is also about participatory methodologies to strengthen the capacity of farmers and other actors, to improve agriculture and adapt it to changing needs and conditions. LEISA seeks to combine indigenous and scientific knowledge and to influence policy formulation to create a conducive environment for its further development. LEISA is a concept, an approach and a political message.

AMEF is a member of AgriCultures Network, which is involved in co-creation and sharing of knowledge on family farming and agro ecology. The network is locally rooted and globally connected. Besides magazines, the network is involved in multi stake holders' engagement and policy advocacy for promotion of small holder family farming and agroecology. The network consists of members from Brazil, Ethiopia, India, Netherlands, Peru and Senegal. The secretariat of the network is located in IED Afrique, Dakar, Senegal.

MISEREOR founded in 1958 is the German Catholic Bishops' Organisation for Development Cooperation. For over 50 years MISEREOR has been committed to fighting poverty in Africa, Asia and Latin America. MISEREOR's support is available to any human being in need – regardless of their religion, ethnicity or gender. MISEREOR believes in supporting initiatives driven and owned by the poor and the disadvantaged. It prefers to work in partnership with its local partners. Together with the beneficiaries, the partners involved help shape local development processes and implement the projects. This is how MISEREOR, together with its partners, responds to constantly changing challenges. (www.misereor.de; www.misereor.org)

AME Foundation promotes sustainable livelihoods through combining indigenous knowledge and innovative technologies for Low-External-Input natural resource management. Towards this objective, AME Foundation works with small and marginal farmers in the Deccan Plateau region by generating farming alternatives, enriching the knowledge base, training, linking development agencies and sharing experience.

AMEF is working closely with interested groups of farmers in clusters of villages, to enable them to generate and adopt alternative farming practices. These locations with enhanced visibility are utilised as learning situations for practitioners and promoters of eco-farming systems, which includes NGOs and NGO networks. **www.amefound.org**

11 Integrated farming in small holder farms for livelihood and nutritional security

Kathiresan Ramanathan

Farmers of coastal Tamil Nadu are compelled to grow rice despite its low returns, as rice alone has the unique feature of withstanding water stagnation for a longer period of time. Integrating fish culture and poultry rearing in rice helped farmers in 3 coastal districts in Tamil Nadu to double their income and enhance the nutritional status of their families.

22 A journey towards integrating dairy

Archana Bhatt, Raveendran and Abdulla Habeeb

While adversity inspired her to start a new initiative, the training and the support she received from external agencies made her dream possible and sustain. Lilly Mathews is a case to draw inspiration in converting an adversity into an opportunity. Completing 25 years in dairy farming, she is now a role model to reckon with, in the region.

25 Traversing through the traditional agro-pastoral systems in India

Rituja Mitra and Sahith Goverdhanam

The interlinkages between pastoralism and agriculture have the potential to play a key role in transitioning to a green, environmentally sustainable and global economy. Examples of pastoral systems across the country provide an understanding of their knowledge systems in the management of natural resources, adapting toward local climatic conditions, and the economic and ecological value created from the livestock manure in enhancing soil fertility.

34 Farm integration returns more

J Krishnan

Integrated Farming Systems (IFS) involves linking several components of the farm system. Resource flows are established between components. The 'outputs' from one component serve as 'inputs' for another. IFS approach is the way forward for resource optimization, utilization; sustaining and improving farm productivity and farm livelihoods; cultivating nutritious, healthy and diverse food and animal feed, besides meeting other rural needs.

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Resilient crop-livestock systems

Traditionally farming meant a combination of crops, animals, fishery etc. However, these traditional farms were gradually replaced by specialised farms, be it monocropping or commercial animal farms, in pursuit of higher returns. But this transition made farming more risky and highly dependant on expensive external inputs. With a majority of the farming community belonging to small and marginal category, who are most vulnerable to the vagaries of nature and the markets, specialised farms are no longer a choice to reckon with. Its time to move towards diverse farms or integrated farms.

Diversified systems consist of components such as crops and livestock that co-exist independently from each other. Diversified systems are a combination of specialized subsystems that aim to reduce risk in conditions of variable but relatively abundant resources. Integration is done to recycle resources efficiently. Integration occurs most often, however, in Low External Input Agriculture (LEIA) farming systems that exist in many tropical countries where products or by-products of one component serve as a resource for the other - dung goes to the crops and straw to the animals. In this case the integration serves to make maximum use of the resources. An important aspect in promoting mixed farming is that the yield of the total enterprise is more important than the yield and/or efficiency of the parts. (FAO, p.6)

Mixed farms are systems that consist of different parts, which together should act as a whole. They thus need to be studied in their entirety and not as separate parts in order to understand the system and the factors that drive farmers and influence their decisions. For example, farmers of coastal Tamil Nadu are compelled to grow rice despite its low returns, as rice alone has the unique feature of withstanding water stagnation for a longer period of time. Integrating fish culture and poultry rearing in rice helped farmers in 3 coastal districts in Tamil Nadu to double their income and enhance the nutritional status of their families. (Kathiresan Ramanathan, p.11)

Integrated Farming Systems (IFS) involves linking several components of the farming system. Resource flows are established between components. The 'outputs' from one component serve as 'inputs' for another. IFS approach is the way forward for resource optimization, utilization; sustaining and improving farm productivity and farm livelihoods; cultivating nutritious, healthy and diverse food and animal feed, besides meeting other rural needs. Thamilarasi, a farmer in Tamil Nadu who was growing a single crop earlier, could now earn more, by integrating animals to the diversified cropping systems on her farm. Besides increased income, she could get nutritious food for the family and home grown feed for livestock, by recycling plant and animal wastes. (Krishnan J., p.34)

Similarly, Lilly Mathews is a case to draw inspiration in converting an adversity into an opportunity. Starting with 10 cows in 2008, she has expanded her diary enterprise by adding milking machines and value addition products. The dairy enterprise in turn is sustaining her cropping systems.(Archana Bhatt, et.al., p.22)

Diversification, besides reducing risk and providing more income, also acts as a pest control measure. By including certain species like marigold on the borders, the main crop suffers lesser pest incidence. For instance, Thamilarasi (p.34) planted castor as trap crop to protect groundnut from insects (larval stage) attack, and sorghum on outside border as preventive measure to stop sucking pests entry.

Between-farm mixing occurs between pastoralists and farmers. The linkage can help the farmers access organic manure at a local level and also supplement the income of pastoralists with the exchange of manure with farmers. These examples of pastoral systems across the country

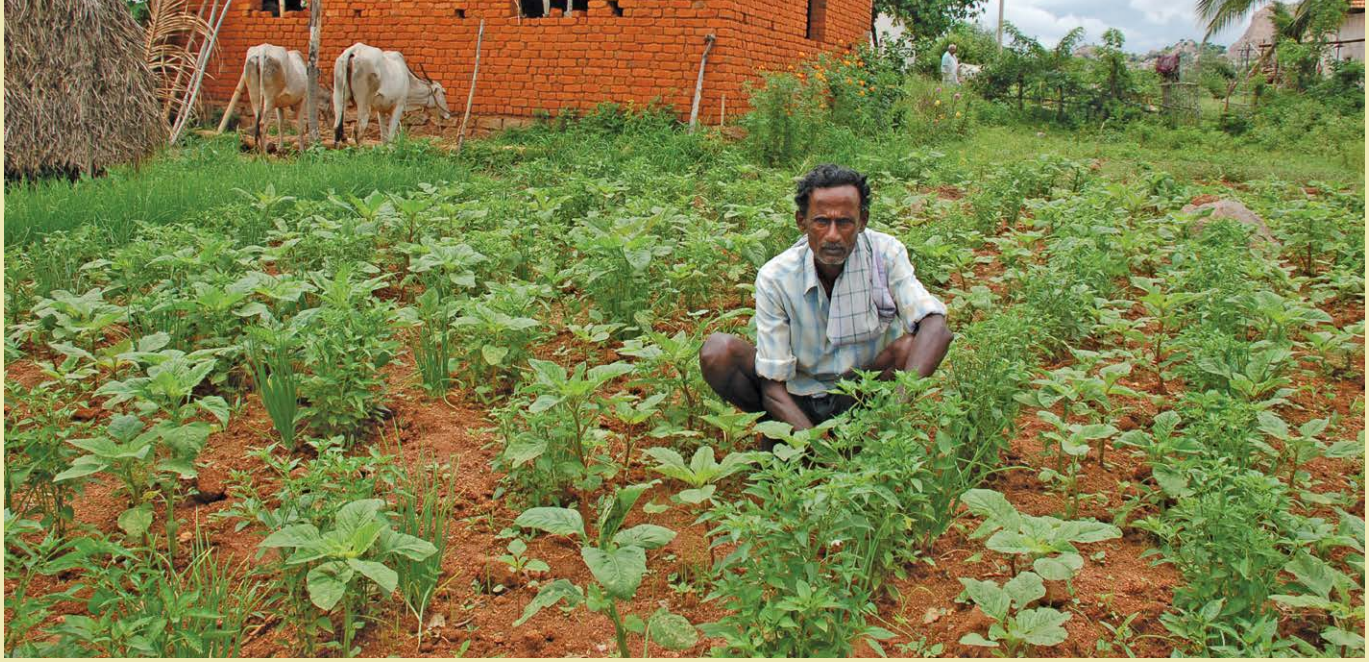

Photo: S Jayaraj for AMEF

Mixed farming is a risk reducing option for small farmers

provide an understanding of their knowledge systems in the management of natural resources, adapting toward local climatic conditions, and the economic and ecological value created from the livestock manure in enhancing soil fertility. In Gujarat's Saurashtra region the pastoralists locally known as Maldharis- Bharwads, Rabaris travel to different parts of the state in search of fodder to sustain their livestock, enroute to the grazing resources they are also dependent on the farmer's land for fodder. Also, most of the sheep rearers from the Kurumas community in Anantapur, Andhra Pradesh, visit the farmer's land in search of fodder. In lieu, the farmers provide them food, shelter and offer clothes. Such relationships and interdependencies not only secure the small farm holders but secure the livelihood of pastoralism as an occupation. (Rithuja Mitra and Sahith, p.25)

Local innovations

During summer, farmers face green fodder scarcity and animals need green fodder with more water content. Understanding that Spinless cactus with 80 -85% water content, as the best alternative to green fodder, especially in summers, BAIF in Karnataka is successfully promoting cactus as livestock fodder among farmers in South Indian States.(I I Hugar, p.28)

Mr. Rajarathinam, a retired Engineer from Tamil Nadu took up farming with his innovative ideas, after his retirement. Having crops and animals, the farmer ventured into setting up bio gas digester as he believes it to be one of best options for promoting sustainable agriculture. (Rajarathinam K., p.31)

External support helps

While progressive farmers do try out innovative ideas on their farms, majority of the farming communities will need support to initiate diversified integrated farming systems. Lilly Mathews in Kerala, could diversify into dairy farming only because of the support provided by the government departments and other organizations in her journey. The initial support to buy 10 cows was provided by the Animal Husbandry department, Kerala, which she proudly acknowledges.

Similarly, Krishi Vigyan Kendras have been instrumental in helping farmers adopt integrated systems. Lyngrah's farm, now a model farm, serves as an example of such support provided by KVK, Meghalaya (p.16). Also, the farming system design of Rice+Fishery+Poultry was upscaled with farmers in Cuddalore, Villupuram and Nagapattinam through a World Bank – Indian Council of Agricultural Research funded National Agricultural Project (NAIP), with the main objective of enhancing the sustainable rural livelihoods in the state of Tamil Nadu in India. (Kathiresan Ramanathan, p.11).

The few examples of linking several systems on the farm included in this issue indicate that integrated farming system has the potential to play a key role in transitioning towards an environmentally sustainable economy. There is a need to develop systems and provide much needed support that can support such transition.

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Characterization of mixed farms

Mixed farming is common worldwide, in spite of a tendency in agribusiness, research and teaching towards specialized forms of farming. Obviously, mixing has both advantages and disadvantages. For example, farmers in mixed systems have to divide their attention and resources over several activities, thus leading to reduced economies of scale. Advantages include the possibility of reducing risk, spreading labour and re-utilizing resources. The importance of these advantages and disadvantages differs according to the sociocultural preferences of the farmers and to the biophysical conditions as determined by rainfall, radiation, soil type and disease pressure.

What is mixed farming?

Mixed farming exists in many forms depending on external and internal factors. External factors are weather patterns, market prices, political stability, technological developments, etc. Internal factors relate to local soil characteristics, composition of the family and farmers' ingenuity. Farmers can decide to opt for mixed enterprises when they want to save resources by interchanging them on the farm - because these permit wider crop rotations and thus reduce dependence on chemicals, because they consider mixed systems closer to nature, or because they allow diversification for better risk management.

There is wide variation in mixed systems. Even pastoralists practise a form of mixed farming since their livelihood depends on the management of different feed resources and animal species. At a higher level, a region can consist of individual specialized farms and service systems that together act as a mixed system. Other forms of mixed farming include cultivation of different crops on the same field, such as millet and cowpea or millet and sorghum, or several varieties of the same crop with different life cycles, which uses space more efficiently and spreads risks more uniformly.

The study of a wide variety of mixed systems at different levels is beneficial to understanding the logic of mixed systems in general. Disciplines such as ecology, economics and complex system theory have tools and concepts that can help us to understand better the mixed blessings of mixed systems. One essential point here is that the principle of mixing occurs everywhere, also in society - domestic waste such as glass, bottles or paper is also recycled. Another point is that in mixing, the different functions of plants and animals can be observed: a cereal crop produces grain and straw, a legume provides grain, organic matter, fodder and nitrogen. A third point is that it tends to be more important to look for high yield of the combination of the components rather than for the (high) yield of one component. Mixed farms are systems that consist of different parts, which together should act as a whole. They thus need to be studied in their entirety and not as separate parts in order to understand the system

and the factors that drive farmers and influence their decisions.

Forms of mixed farming

Mixed farming systems can be classified in many ways - based on land size, type of crops and animals, geographical distribution, market orientation, etc. Three major categories, in four different modes of farming, are distinguished here. The categories are:

- On-farm versus between-farm mixing (Box 1)
- Mixing within crops and/or animal systems
- Diversified versus integrated systems

The modes of farming refer to different degrees of availability of land, labour and inputs, ranging from plenty of land to a shortage of land. The modes are characterized as expansion agriculture (EXPAGR, plenty of land), LEIA, HEIA and new conservation agriculture (NCA, a form of land use where shortages are overcome by more labour, more inputs and keen management).

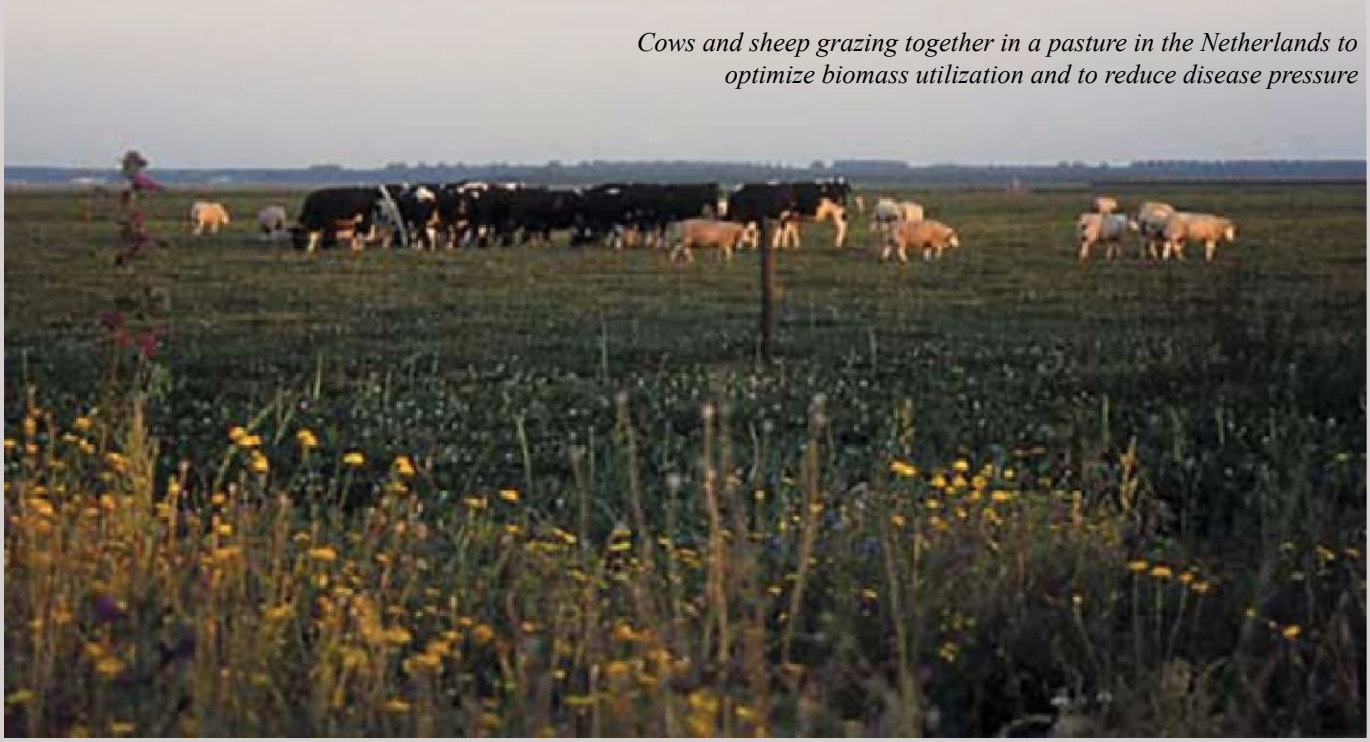
On-farm versus between-farm mixing

On-farm mixing refers to mixing on the same farm, and *between-farm mixing* refers to exchanging resources between different farms. On-farm mixing occurs particularly in LEIA where individual farmers will be keen to recycle the resources they have on their own farm. Between-farm mixing occurs increasingly in HEIA systems - in countries such as the Netherlands it is used to mitigate the waste disposal problems of specialized farming. Crop farmers use dung from animal farms, a process that involves transport and negotiation between farmers and even politicians. Between-farm mixing also occurs at the regional level. In tropical countries also, manure may be transported from livestock farms to farmers and vegetable cropping areas where manure is in short supply.

Box 1: Buffaloes in a smallholder dairy in the Hindu Kush-Himalayas: A case of between-farm mixing

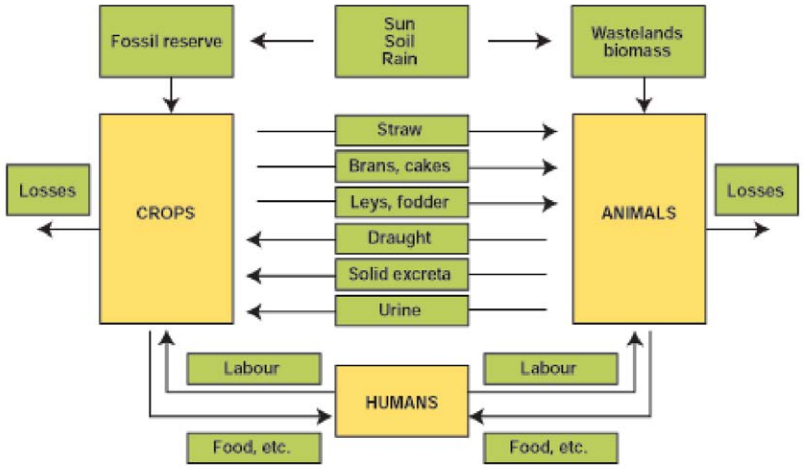
A farmer buys a milch buffalo from a lowland buffalo trader at a price of between Rs 23 000 and 28 000. The animal is milked for eight months to a year and the gross income amounts to Rs 25 000-30 000. Some farmers sell expectant bakerno buffaloes for Rs 18 000-20 000 after one year of milking and buy an in-milk buffalo laino from the trader at a price of Rs 25 000-30 000 to ensure continued milk production. If the farmer waits for the bakerno buffalo, it takes about eight months before it calves and begins producing milk. The strategy is most suitable for smallholders who manage only one buffalo, but farmers who have more than one buffalo also adopt it. The lactating buffaloes come from the lowland areas where conception is easier.

Cows and sheep grazing together in a pasture in the Netherlands to optimize biomass utilization and to reduce disease pressure



Pastoralists from such systems in West Africa and on the Indian subcontinent also exchange cattle and crop products with crop farmers. Cultivators receive manure, labour and, less important, milk in return for cash, grain and water rights traded to pastoralists. Entrustment of livestock from crop farmers to pastoralists follows more or less the same rules. In return for taking care of the herd, herders receive either cash, or cropland, or labour for the cropland or a share of the milk and the offspring.

Fig. 1: An outline of different resource flows in mixed crop-livestock systems



Mixing within crop and/or animal systems

Mixing within crop and/or within animal systems refers to conditions where multiple cropping is practised, often over time, or where different types of animals are kept together, mostly on-farm. Both these systems occur frequently though they are not always apparent.

Within-crop mixing takes place where crop rotations are practised over and within years. For example, a farmer has a grain-legume rotation to provide the grain with nitrogen or a potato-beet-grain rotation to avoid disease in the potatoes. Plants can also be intercropped to take maximum advantage of light and moisture, to suppress weeds or prevent leaching of nutrients through the use of catch crops. Examples of mixing between animals are found in chicken-fish pond systems where chicken dung fertilizes the fish pond; in beef-pork systems where pigs eat the undigested grains from the beef cattle dung; or in mixed grazing such as cow-sheep mixes to maximize biomass utilization or to suppress disease occurrence.

Diversified versus integrated systems

Diversified systems consist of components such as crops and livestock that co-exist independently from each other. In particular, HEIA farmers can have pigs, dairy and crops as quite independent units. In this case the mixing of crops and livestock primarily serves to minimize risk and not to recycle resources.

Integration is done to recycle resources efficiently. It occurs in mixed ecological farms of temperate countries (here called the mode of new conservation agriculture, NCA), but also in mixed, relatively low input farms of southern and southwestern Australia with grain-legume-sheep mixtures. Integration occurs most often, however, in LEIA farming systems that exist in many tropical countries where products or by-products of one component serve as a resource for the other - dung goes to the crops and straw to the animals. In this case the integration serves to make maximum use of the resources. Unfortunately, these systems tend to become more vulnerable to disturbance because mixing of resource flows makes the system internally more complex and interdependent.

In Asia, the integration of livestock, fish and crops has proved to be a sustainable system through centuries of experience. In China, for example, the integration of fishpond production with ducks, geese, chickens, sheep, cattle or pigs increased fish production by 2 to 3.9 times, while there were added ecological and economic benefits of fish utilizing animal wastes. Environmentally sound integration is ensured where livestock droppings and feed waste can be poured directly into the pond to constitute feed for fish and zooplankton. Livestock manure can be used to fertilize grass or other plant growth that can also constitute feed for fish. Vegetables can be irrigated from the fishponds, and their residues and by-products can be used for feeding livestock.

Grazing of livestock under plantation trees such as rubber, oil palm or coconut is a form of crop-livestock integration that is often found in Southeast Asia. Experiments in Malaysia with cattle and goats under oil palm showed better oil palm bunch harvest and comparable results

were found where goats fed under rubber trees. In rubber and oil palm plantations in Malaysia, the integration of livestock to utilize the vegetative ground cover under the tree canopy increased overall production and saved up to 40 percent of the cost of weed control. Similarly, sheep helped to control weeds in sugar cane fields in Colombia.

The best known type of integrated mixed farming is probably the case of mixed crop-livestock systems. Cropping in this case provides animals with fodder from grass and nitrogen-binding legumes, leys (improved fallow with sown legumes, grasses or trees), weeds and crop residues. Animals graze under trees or on stubble, they provide draught and manure for crops, while they also serve as a savings account (Figure 1).

Mixed crop-livestock systems, different modes

Even in integrated systems the exchange of resources such as dung, draught and crop residues takes place in degrees that differ among the so-called modes of farming, based on the availability of land, labour and capital respectively.

- Expansion agriculture (EXPAGR)
- Low external input agriculture (LEIA)
- High external input agriculture (HEIA)
- New conservation agriculture (NCA)

Box 2: More mixing of livestock

By keeping several species, farmers can exploit a wider range of feed resources than if only one species is kept. In pastoral areas, camels can graze up to 50 km away from watering points, whereas cattle are limited to a grazing orbit of 10-15 km. Camels and goats tend to browse more, i.e. to eat the leaves of shrubs and trees; sheep and cattle generally prefer grasses and herbs. Different animal species supply different products; e.g. camels and cattle can provide milk, transport and draught power, whereas goats and sheep tend to be slaughtered more often for meat. Chickens often provide the small change for the household, sheep and goats are sold to cover medium expenditures, while larger cattle are sold to meet major expenditures.

Keeping more than one species of livestock is also a risk-minimizing strategy. An outbreak of disease may affect only one of the species, e.g. the cow, and some species or breeds are better able to survive droughts and thus help carry a family over such difficult periods. Advantage can also be taken of the different reproductive rates of different species to rebuild livestock holdings after a drought. For example, the greater fecundity of sheep and goats permits their numbers to multiply quicker than cattle or camels. The small ruminants can then be exchanged or sold to obtain large ruminants.

Crop and livestock integration: cattle grazing under coconut trees (Sri Lanka)

Different modes of mixed farming

The EXPAGR mode occurs where land is abundant, *i.e.* where shortage of land or local fertility are overcome by migration or by expansion into other regions where bush and forest fallow still occur. Typical examples of mixed farming in this mode are found in West Africa and in old Asian and European grazing systems.

Mixed farming in LEIA occurs where the shortage of land can no longer be overcome by migration or use of substantial areas elsewhere for grazing. Lack of access to external inputs such as fuel, chemical fertilizers or pesticides implies that only increased use of labour and skills offers a way out. This also implies the introduction of modified practices, and the need to adjust demand according to resource availability. Dung is carried around on the farm by using more labour because a lack of soil fertility cannot be compensated by shifting to more land or by employing more livestock to "produce" more dung. In LEIA systems the latter is considered a resource but a waste product in HEIA systems. If not managed properly and if demand for food and other crops is not adjusted to the carrying capacity of the soil, this can result in mining of soils and/or collapse of the systems.

Mixed farming in the HEIA mode is not frequently found because it implies plentiful access to resources such as external feed and fertilizer that make exchange and recycling of resources at farm level not relevant. Exchange of resources between farms only exists, as seen in the section *On-farm versus between-farm mixing*, after the excessive use of fertilizer forces farmers to recycle the waste. In the HEIA mode the demand for output determines the use of inputs. The use of external resources can reach such high levels that the environment is affected by emissions from the crop and/or animal production systems, ultimately leading to waste disposal problems, thus forcing HEIA into NCA.

NCA is a mode of farming where production goals are matched as closely as possible to the resource base. This approach represents a mix between HEIA and LEIA, i.e. it aims to replace the removed nutrients but it also aims to achieve keen farming and adjusted cropping and consumption patterns to suit local conditions. The use of leys (improved fallows for grazing) is important to regenerate soils, to add nitrogen, to mobilize phosphate and to suppress weeds (i.e. to avoid herbicides).

Dung, a valuable resource

Concluding comments

Mixed systems occur in several forms. For example, pastoral systems have experience in the management of mixed herds and of livestock with feed resources. One form of mixing occurs where livestock is kept on grazing lands distant from cropland in the EXPAGR mode where land is abundant. Mixed systems can also occur as a combination of specialized farms that exchange resources among them, particularly in HEIA. Diversified systems are a combination of specialized subsystems that aim to reduce risk in conditions of variable but relatively abundant resources. Strong integration is associated with LEIA and NCA conditions where use of resources such as fertilizer and fossil fuel is restricted because of problems with pollution. This gives clues to development workers and policy-makers: cheap resources lead to specialization, restricted use of resources leads to mixing. An important aspect in promoting mixed farming is that the yield of the total enterprise is more important than the yield and/or efficiency of the parts.

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Note: This is an edited version of the second chapter on Characterisation of Mixed Farms in ***Mixed crop-livestock farming, A review of traditional technologies based on literature and field experience****, FAO Animal Production and Health Papers 152, ISBN 92-5-104576-3; © FAO 2001. The soft copy of the source is available at https://www.fao.org/3/y0501e/y0501e03.htm#P1_9*

Integrated farming in small holder farms for livelihood and nutritional security

Kathiresan Ramanathan

Farmers of coastal Tamil Nadu are compelled to grow rice despite its low returns, as rice alone has the unique feature of withstanding water stagnation for a longer period of time. Integrating fish culture and poultry rearing in rice helped farmers in 3 coastal districts in Tamil Nadu to double their income and enhance the nutritional status of their families.

Poultry cages are installed directly in the rice field

Rice based farming systems are the main economic activities of millions of rural poor in Asia, Africa and Latin America. Asia alone has 200 million rice farms smaller than 1 ha, accounting for 90% of world Rice production. However, rice had always been a compulsory crop rather than an optional one for the farmers of the coastal rice tracts and wetlands all over Asia. This is because the whole of the tracts are depending on monsoon rains as the main source of irrigation, wherein the distribution of rainfall is irregular with heavy down pour

during a particular and shorter period of the year leading to inundation and flooding. Further, drainage of water into the sea also becomes difficult during these periods as the sea backlashes with heavy tidal incursions. Added to this situation, most of these rice tracts have heavy textured soil types, making percolation of water difficult. All these result in stagnation of water during the cropping seasons of these tract. Among the choice of crops for cultivation, rice alone has the unique feature of withstanding water stagnation for a longer period, whereas all other crops will perish within a very shorter period of water stagnation. Thereby, the farmers of these regions are compelled to grow rice during the cropping seasons, in spite of the fact that the economic margin from rice grown is very little and even inadequate to support their livelihood. Inadequate livelihood, enforces on these small holder women farmers, malnourishment, low birth weight and child wasting. The constraints therefore identified are monsoon dependent crop seasons with ill-distributed rainfall; frequent inundation or drought and crop failure; marginal returns from rice; lack of diversification of enterprises and poor economic status, under nourishment and migration to urban centres.

Human requirements for protein are estimated to be 55 g per day for adult man and 45 g per day for woman at normal health conditions. The qualities of protein from animal sources compare better than plant sources interms of Net Protein Utilization (NPU) around 0.75 as against many of plant sources that have NPU around 0.5 to 0.6. The value of meat is that, it has a concentrated source of high quality protein (NPU), highly digestible (about 0.95 compared to 0.8 – 0.9 with many plant sources) and provides surplus of one essential amino acid Lysine which is inadequate in most cereals. By 2050, an extended world population would consume two thirds more animal protein that it does today (FAO 2017). Poultry meat is the key player of growth in total meat production in response to increasing global demand, by virtue of lower production cost making it a more affordable protein (OECD, 2016).

In this background, an appropriate design of an integrated farming system with a judicious mix of crop and animal components as a resource management strategy would be the best approach to address this issue. Besides, this IFS design would also augment household diet diversity and nutritional standards of resource poor farmers.

Integrated rice, fish and poultry farming system

The salient features of a conventional Rice + Fish + Poultry system as demonstrated until now are,

- In one acre rice field, 90 cents rice area is left undisturbed and 10 cents is excavated as a fish pond without any rice crop.
- A poultry cage is installed in the fish pond and the fish component and poultry component do not directly integrate with rice. The poultry manure needs to be collected at the end of the season after draining the pond for application to rice field which is laborious.
- Mostly layer birds are raised in the poultry cages.

In the Rice + Fish + Poultry system demonstrated and upscaled by Annamalai University here in after termed as Annamalai Rice + Fish + Poultry system, the salient features of difference are as listed below:

- The poultry cages are installed directly in the rice field with the help of four concrete posts 8' high, 4' buried inside and 4' protruding above, that lifts the cage above the crop canopy. The cage bottom is of wire mesh, that leaves the poultry waste to reach the rice fields below, wherein they get dissolved in standing water and serve both as a crop manure as well as fish feed.
- The fish trenches that accommodate the fishes, as a permanent shelter are 1m deep and posses a width of 1 m at the top and 0.75 m at the bottom and they run along the side of the rice field, occupying 10 per cent of the rice fields. The fish fingerlings as a polyculture with Catla, Rogu, Mrigal and Common Carp in equal proportions of a stocking density of 5000 fingerlings ha^{-1} (100 fingerlings for every

With integration, fishes help in pest and weed control in rice, poultry compliments rice with slow paced addition of nutrient rich organic matter.

Table 1: Livelihood enhancement in wetland clusters

Particulars	Villupuram	Cuddalore	Nagapattinam	Weighted mean of the three districts
No. of poultry bird rearing	7	5	5	5
Average meat yield/bird (kg)	2.40	2.50	2.10	2.3
Average meat yield/household (kg)	336	250	210	2.65
Cost of meat Rs. /kg	100	110	90	100
Gross return from poultry (Rs.)	33,600	27,500	18,900	26,666
Cost of production of poultry bird (Rs.)	9,900	5,700	7,100	7,566
No. of Fish rearing	2	1	1	1
Fish yield/ household (kg)	120	75	75	90
Fish cost Rs. /kg	70	90	80	80
Gross return from fish (Rs.)	8,400	6,750	6,000	7,050
Cost of production of fish (Rs.)	900	500	500	633
Total net return, household / year (Rs.)	31,200	28,050	17,300	25,516
Livelihood enhancement (%)	98	88	54	80

200 m^2 plot considering the rice field dimension and not the trench dimension) are released after 15 days of transplanting rice seedlings. They swim into the rice fields and feed on the pests and weeds during morning and evening hours and take shelter in the trench during day time with sunny weather to avoid temperature fluctuation of shallow water column standing in the rice field.

- The poultry cage dimension and poultry stocking density are optimized through rigorous experimentation. Cages are of dimension 6'x4'x3' accommodating 20 broiler birds in each cage. Larger cages hamper crop growth because of shading and higher stocking density could harm the crop by increased volume of poultry litter per unit area that are acidic in nature.
- This way, a perfect integration of all the three components, with fishes helping pest and weed control in rice, poultry complimenting rice with slow paced addition of nutrient rich organic matter up to 8.5 t ha^{-1} in every crop season and weed control by acidic nature of the litter as well as allelomediatory principle, is evolved in this design.

Table 2: Impact on Human Nutrition

Intervention	Consumption of Animal Protein		
		Before Intervention	After Intervention
Annamalai Rice + Fish + Poultry	Poultry meat	2.8 kg / Month	4.00 kg/ Month
	Fish meat	0.5 kg/ Month	4.00 kg/ Month
Annamalai Rice + Fish + Poultry	**Nutritional Parameters**		
	Blood Bio chemical	**Before Intervention**	**After Intervention**
	Blood hemoglobin	11.7 g/dl	13.9 g/dl
	Serum Albumin	4.20 g/dl	4.87 g/dl
	Serum Globulin	1.94 g/dl	2.79 g/dl
	Folic Acid	7.61 ng/ml	7.61 ng/ml
	Blood Calcium level	9.4	10.05
	Child Anthropometry		
	BMI	13.9	19.5
	Weight	15 kg	20 kg

The fish swim into the rice fields and feed on the pests and weeds

- Further, three generations of broiler birds within one rice cropping season, offers excellent revenue generation that enhances livelihood security of resource poor farmers. In case of natural calamities such as flash floods or drought wherein the crop could totally be damaged, this broiler meat output would offer solace and serve as a climate resilience mechanism.

Participatory research and upscaling

This farming system design was upscaled through a World Bank – Indian Council of Agricultural Research funded National Agricultural Project (NAIP), with the main objective of enhancing the sustainable rural livelihoods in the state of Tamil Nadu in India. The Annamalai Rice + Fish + Poultry Farming System design was disseminated for adoption in 200 m^2 of rice area in each of the 838 farmers holdings. The target area for participatory research included three districts of Tamil Nadu State in Southern India, namely Cuddalore, Villupuram and Nagapattinam. Each district with a cluster including three villages and 100 participating small and marginal farmers, were organized. The cost of infrastructure for the farming system design *Viz.,* poultry cages, concrete posts, fish trenches, chicks, chick feed, fish fingerlings, goat and apiary cages were met from the project funds.

Later during 2015 – 16, the impact of these models on the nutritional impact of farming households were traced in a new cluster for wetland model comprising 75 farming households through a Biotechnology industry Research Assistance Council (BIRAC in collaboration with Bill and Melinda Gates Foundation) funded Grand Challenges India, Project. The impact assessment on sustainability and livelihoods were done by Annamalai University and M/S. Price Water House Cooper, Kolkata, India. The impact on nutritional status and diet diversification of farming households were done by M/S. Sathguru Consultants, Hyderabad, India.

Impact on livelihoods and farm production

The baseline survey of the project indicated that the gross household annual income in Wetland clusters is Rs.31,822.11. Increases in income for these three districts through the adoption of Rice + Fish + Poultry farming are presented in Table 1. The increase in Gross household income in Villupuram district is Rs.31,200 which is accounting for 98 per cent, the highest, as the number of broiler rearing spread over three crops of rice is seven. The increase in gross household income in Cuddalore district is Rs.28,050, that contributes only 88 per cent increase. This is because of the fact that water availability in the wetland cluster of this district does not permit more than one crop and hence, only four broiler rearings are possible. However, the farmers are enthusiastic about the intervention as is evident from one broiler rearing that extended outside the three that are possible during the single crop of rice. The increase in gross household income is the least at Rs.17,300 that makes only 54 per cent increase with in an year, in Nagapattinam district. Though two crops of rice are grown and poultry rearings for five generations are taken up, the meat yield and market prices are comparatively lower than that experienced at Cuddalore.

Addition of poultry manure in five cents of rice area has added nutrients more than the quantity that could have been possible through the normally recommended dose of Farm Yard Manure. Higher nutrient addition through

The rice, poultry and fish integrated model

poultry manure compared to other organic sources in rice is already observed in institutional and on-farm experiments. Pest incidence in rice is also reduced due to integration of the fish culture and poultry components, owing to the feeding habits of fishes that suppresses the egg masses, larvae and alternate weed hosts of pests. Productive employment generation was also seen with this technology with 219 mandays/year/household of additional employment generation.

The striking success of this Rice + Fish + Poultry farming system has made 392 other farmers (other than the 838 identified development partners) to adopt this in their holdings. Further 12 of the identified development partners have been extending the technology from the project supported 200 m^2 area to half an acre (2000 m^2) of their holdings.

This intervention spread through 3 villages during 2015-16, resulted in the production of 9,000 kg of broiler meat and 2,250 kg of fish meat. This was reflected in the increased poultry meat intake of 4 kg/ month by the participating farming households from the baseline value of 2.8 kg/month (Table 2). The fish meat intake also showed an increase with 4 kg/month from 0.5 kg/ month of baseline value. The blood haemoglobin count of the development Partner or beneficiary of wetland cluster increased from 11.7 gm/dl to 13.9 gm/, folic acid level from 7.61 ng/mL to 8.76 ng/mL, serum albumin from 4.20 gm/dl to 4.87 gm/dl, calcium level from 9.4 to 10.05, globulin from 1.94 gm/dl to 2.79 gm/dl (sampled from an average of 10 beneficiary women farmers).

Conclusion

Integrating fish culture and poultry rearing in rice as in Annamalai Rice + Fish + Poultry farming system helps to double the farmers income and enhances the nutritional status of the farming households. The models could be up scaled in all the rice growing regions of the world with transplanted and wetland mode of cultivation of rice, predominated by small holder farms.

Acknowledgements

The funding support from NAIP-ICAR and BIRAC Grand Challenges India Agriculture and Nutrition are gratefully acknowledged.

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Integrated Farming System

Mawsiatkhnam KVK East Khasi Hills, Meghalaya

Krishi Vigyan Kendras have been instrumental in helping farmers adopt integrated systems on the farm, thereby helping them produce more and earn more. Lyngrah's farm, now a model farm, serves as an example of such support provided by KVK.

Shri Wallam Kupar Lyngrah, a dedicated progressive and innovative farmer, hails from the village Mawsiatkhnam of Mawlai C&RD Block, East Khasi Hills district of Meghalaya. He is a graduate and a teacher by profession. He started devoting his time focusing on better farming practices. He owns a total of 4.94 acres of land of which 2.50 acres has been converted into an Integrated Farm.

As an agriculture entrepreneur, Mr. Lyngrah felt that conventional method of agricultural cultivation minimized the yield and income. It is also associated with low productivity, increased cost on agriculture inputs and poor or no utilization of existing resources available on the farm. The conventional method also produced ecological problems in terms of limited crop diversity as well as creating soil and water pollution.

His journey towards becoming a sustainable farmer began when he was searching for a solution towards sustainable agricultural methods. It was then when he came into close contact with officials from Krishi Vigyan Kendra, East Khasi Hills district in the year 2013. He received technical guidance on sustainable agriculture through integrated farming. He was also inspired by an exposure visit to Indian Council of Agricultural Research for NEH Region, Umroi Road, Umiam, Ri-Bhoi district, Meghalaya, where he was introduced to the concept and the income opportunities of Integrated Farming System. He gathered technical knowhow by attending a number of trainings programmes, seminars, workshops conducted by the KVK as well as other line departments. He established an integrated farm in a total of 2.50 acres of land area since 2015 with poultry and piggery units as the main components in the farm. Equipped with a strong foundation about integrated farming, Shri Lyngrah further developed his farm by incorporating additional components to his unit.

Details of Components

The integrated farm at present has the following components distributed over 2.5 acres of land:

i. Horticulture Unit
ii. Animal Husbandry and Livestock Unit
iii. Vermicompost Unit

i. Horticulture Unit

The horticultural unit includes vegetable crops like cabbage, cauliflower, chilli, ginger, chow-chow, etc., fruit crops like papaya, pineapple, Assam lemon, orange etc. Krishi Vigyan Kendra, East Khasi Hills District has been giving special emphasis on effective utilization of land by growing assorted vegetables all through the year which increase the farm income and sustain the soil health. After undergoing numerous training programmes

he understood that vegetable crops occupy an important place in diversification and an important role in food and nutritional security. In his village Mawsiatkhnam, year round production of vegetables is possible inside the polyhouse. Growing second crop in the open field is very difficult due to higher rainfall during May to October. As he could not afford to construct the polyhouse by himself he approached Krishi Vigyan Kendra, which in turn through the Ministry of Agro Textiles in collaboration with SASMIRA has helped him in constructing one polyhouse at a subsidized rate. Now, he produces vegetables throughout the year and is getting year round income from this activity.

ii. Animal Husbandry and Livestock Unit

a) Poultry Unit

He started poultry rearing with fifty birds in his farm in the year 2000. However, he was not getting the returns as expected. Later, he enhanced his poultry farming activities by doubling the number of birds. He started to rear layer birds (*BV 360*) whereby he faced problems regarding scientific poultry rearing. To overcome the problems, he started adopting new technologies. However, he still suffered losses. On keenly observing, he found that the birds are fond of laying eggs on corners and where there are darker shades. Realizing this, he constructed the laying cabins which attracted the birds for laying their eggs. A specific dimension was maintained in the cabins preventing breakage of eggs (0% breakage of eggs) during laying. Provisions for collecting the eggs was made in the form of hinged top covers so as to facilitate easy collection of eggs from the cabin without entering the poultry shed. By adopting this method, he could increase the production of eggs from his farm and at the same time could minimize the death of birds. On an average, the modified innovative technology adopted by the farmer reduced the spoilage of eggs by 90% and increasing the productivity by 80-90%. The method adopted by the farmer involves low investments with high productivity and low mortality rate of the birds, which makes it economically more viable.

b) Piggery unit

Pigs are the most common and preferred livestock species in East Khasi Hills district. Almost 80% of farming households in the region rear pigs (mostly 1-2 pigs/household) mainly for fattening purpose. The production process is traditionally based on indigenous breeds. Moreover, pig producers have traditional knowledge and skills for fattening purpose, but few have the skills to breed pigs. Seeing this opportunity, he started the piggery breeding unit. He is rearing 9 sows and 1 boar where one sow gives at least 1 farrowing per year. The demand for pork meat in the market is high, offering good scope for improvement/expansion.

c) Goatery Unit

The unit consists of 15 numbers of goats which were reared in a fenced area in which they graze. Zero expenditure was incurred for feed. Expenses for fencing and low cost shed was around Rs. 5,000 only. The goats are sold in the local market.

d) Fishery Unit

In the year 2018, he constructed 3 numbers of fish ponds with a production capacity of 600 kg/0.3 ha and the average cost of the fishes in the local market was Rs 200/kg. By products from all units of the farm serve as fertilizer and feed to the fish ponds.

iii. Vermicompost Unit

He has 2 vermi-beds of 6x4x2 ft. size with an annual capacity of producing 3000 kg of vermicompost on an average. This is entirely used for all the crops on his farm. Raw materials from the farm are the substrates used for composting all year round.

> Mr. Lyngrah is now an influencer and motivator to others farmers with regard to improved farming practices.

Impact

The new technologies developed by the farmer are being practiced by him for the past 3 years, proving to be economically rewarding. Shri Wallam K. Lyngrah's farm is now a model farm. Farmers in his village and of

Table 1: Total cost incurred and net income received from each of the components of the Integrated Farm

Components	Area/Nos.	Gross Income	Net Income	B:C
Horticulture unit				
Protected Cultivation (since 2018)	1 (500 m2)	1,10,000.00	45583.00	**0.71 (1st Year)**
Open cultivation	Ginger	2,40,000	182508.00	**3.20**
Animal Husbandry & Livestock				
i. Poultry	Layers	8,76,000.00	7,09,140.00	**4.25**
	Local Breed	18,000.00	8,556.00	**2**
ii. Goatary Unit	15 nos.	60000.00	38000.00	**1.73**
iii. Piggery Unit	1(9sows+1boar)	6,00,000.00	4,31,419.00	**2.4**
iv. Fisheries (estimate)	Fisheries (estimate)	15000.00	35000.00	**2.3**

the district who own poultry sheds have been motivated by his success and those having poultry sheds have adopted the award winning innovative idea "***Low cost Poultry Layer shed***". He is a role model to other farmers who are aspiring to set poultry layer farm in the district as well as in other parts of the state. He is integrating all the existing resources available on his farm. He is running his farm successfully. As a progressive farmer he has been always open to skill development and is eager to know every aspect of farming through various sources *viz.* trainings, meeting experts from various line departments etc. He is now an influencer and motivator to other farmers with regard to improved farming practices**.** Hailed as one of the innovative farmers in East Khasi Hills district, he is one of the key trainers on IFS with special reference to poultry and piggery rearing in the district. He has become role model for establishing a successful Integrated Farming System in his block.

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Himachal's women farmers expand their horizons, without hurting the nature

With training and support, low-cost natural farming is increasing incomes and leading to social empowerment. Women farmers in the hill State of Himachal Pradesh are gradually turning to non-chemical, low cost "natural farming", which has not only provided them with a sustainable livelihood but also empowered them better.

Launched in 2018, the State's Prakritik Kheti Khushhal Yojana is promoting the climate resilient Subhash Palekar Natural Farming (SPNF), also called 'Zero Budget Natural Farming'. Over 1.5 lakh farmers have been trained in natural farming in the State so far, with substantial numbers of women participants. Moreover, the coming together of women from the hill regions for natural farming, regardless of their level of education, has helped them gain confidence in matters beyond agriculture. Practical training in natural farming is helping rural women in Himachal Pradesh gain confidence by supplementing family incomes.

At many other places in the State, women farmers who have shifted to natural farming collectively plan to increase their income by processing fruits and creating marketing networks on their own.

Another group of more than 20 young women in Khaushshah village near Rampur Bushahr in Shimla district had been contributing in agriculture and horticulture at home but, "We were just silent workers with no say in deciding things in the field. The income from apple orchards was falling due to over-use of chemical fertilizers and pesticides. Since we were provided training in the natural farming project, we could move out of the four walls of the house and are now actively involved in changing the course of farming for overall betterment in returns and nutrition," said Sujata, a graduate farmer.

Their group, the Prakritik Kheti Mahila Khushhal Kisan Samiti, Khaushshah, was formed two years back, and registered in 2021. The women farmers' group is doing natural farming individually on land measuring around 12.5 bighas, and the SPNF technique has helped them grow multiple crops like pulses and vegetables, alongside apples, for regular income from the same field. "Besides, it has helped us in connecting socially, and break mindset barriers on issues other than farming also," said the group's members.

Source: https://www.thehindu.com/news/national/other-states/himachals-women-farmers-are-expanding-their-horizons-naturally/article37141852.ece

Tastier, more nutritious, climate-resistant chana soon, thanks to study led by India's ICRISAT

Scientists from around the world have used genome sequencing to help produce new varieties of chickpea, which are expected to give increased yields at about similar input cost. Research led by scientists from International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India is set to help produce more chickpea or *chana*, and make it more nutritious and climate-change resistant.

The worldwide research project has made it possible to cultivate new varieties of one of the most consumed pulses in the world, in a number of forms. These varieties are expected to give increased yields of *chana* at about similar input costs to current varieties, and the new crop is set to be less susceptible to damage, as well as tastier.

The scientists used genome sequencing to produce these new varieties, and made a knowledge bank that can be used for experiments to produce better *chana* in future. The research, the world's largest on plant genome sequencing, was published earlier this week in the science journal *Nature*.

Genome sequencing is a method used to determine the entire genetic makeup of an organism. The genetic study of crop varieties is then used for further improvement by scientific research and biotechnological methods.

The scientists, led by Prof. Rajeev Varshney, research programme director for accelerated crop improvement at ICRISAT, mapped the genomic sequence of *chana* crops from across the world by sequencing 3,366 varieties from 60 countries. Of these, 3,171 were cultivated, while 195 were wild species.

After this study, *chana* is among a club of crops like rice, wheat and maize for which there's extensive genetic information, enabling future advances through applied genetic technology.

Source: https://theprint.in/india/tastier-more-nutritiousclimate-resistant chana-soon-thanks-to-study-led-by-indiasicrisat/768492/

Government provides up to 75% subsidy for cultivation of medicinal plants, herbs

The Ministry of Finance has allotted Rs.4000 crore package for the promotion of *Herbal Cultivation* under *Atma Nirbhar Bharat*. A draft scheme for the cultivation and marketing of medicinal plants has been prepared by the *Ministry of Ayush*. A proposal has been submitted to the Cabinet for approval.

The Government of India's *Ministry of Ayush* implemented the Centrally Sponsored Scheme of National Ayush Mission (NAM) to promote the cultivation of medicinal plants. Market-driven cultivation of 140 prioritized medicinal plants in identified clusters/ zones was supported and implemented in a mission mode through selected State Implementing Agencies across the country, including Andhra Pradesh, have taken it up under the NAM Schemes *"Medicinal Plants"* component.

As per the scheme guidelines, the support was provided for:

- Cultivation of prioritized medicinal plants on farmer's land
- Establishment of nurseries with backward linkages for raising and supply of quality planting material
- Post-harvest management with forwarding linkages
- Primary processing, marketing infrastructure, etc

Encouragement to Farmers:

To encourage farmers to cultivate Medicinal Plants, the *Ministry of Ayush* has provided subsidies of *30%, 50%,* and *75%* of the cultivation cost of prioritized plant species across the country, including Andhra Pradesh. From Fiscal Year 2015-16 to 2020-21, the Ministry of Ayush supported 4349 hectares in Andhra Pradesh under cultivation of Medicinal Plants with a budget of *Rs. 744.60 lakh* under the *National AYUSH Mission (NAM) scheme*.

The National Medicinal Plants Board, Ministry of Ayush, has supported the Andhra Pradesh State Biodiversity Board with two training programs and one nursery project. NMPB has also supported awareness programs for stakeholders on the conservation and sustainable use of medicinal plant resources to the *Andhra Pradesh Medicinal and Aromatic Plants Board*, Andhra Pradesh, from 2015-16 to 2020-21.

Source: https://krishijagran.com/agriculture-world/government-provides-up-to-75-subsidy-for-cultivation-of-medicinal-plants-herbs/

Over 4 crore trees planted in farm land in last 5 years

The Government said over four crore trees have been planted in nearly 94,000 hectares with an expenditure of ₹149 crore during last five years under the 'Har Medh Par Ped' scheme. The scheme is being implemented in 23 States and Union Territories that have liberalised felling and transit-regulations to encourage tree plantation on boundaries of the farm land. Farmers get additional income and it will make farming system more climate resilient, Agriculture Minister Narendra Singh Tomar said in a written reply in Lok Sabha on Tuesday. Between 2016-17 and 2020-21, 808 nurseries have been established, 93,809.27 hectares area has been covered with plantation of 4.02 crore trees, Tomar said.

In another reply, the minister said that yields of rainfed and irrigated rice, wheat and kharif maize are likely to be reduced under projected climate change scenarios if adaptation measures are not taken. The government is addressing the risk associated with climate change by devising appropriate adaptation and mitigation strategies ensuring food security in the country under the National Mission for Sustainable Agriculture (NMSA), he said.

The Indian Council of Agricultural Research (ICAR) under network project 'National Innovations in Climate Resilient Agriculture (NICRA)' conducts strategic research, technology demonstration and capacity building to address impact of climate change on agriculture and agro-based commodities, Tomar said.

ICAR has demonstrated climate resilient technologies namely drought tolerant short duration varieties, crop diversification, integrated farming systems, soil and water conservation measures in most vulnerable districts in the country to minimise impact of climate change.

https://www.thehindubusinessline.com/news/over-4-crore-trees-planted-in-farm-land-in-last-5-years/article37766021.ece

Call for Articles

Urban Agriculture

Vol. 24 No. 1, March 2022

Urban agriculture, urban horticulture farming or urban gardening is the practice of cultivation, processing and distributing food in or around urban areas. Worldwide, this was in response to meeting food requirements of citizens, gainful employment of urban poor, healthy hobby of urban citizens or a conscious planning by administration. With urban expansion, certain cities started expanding in all possible directions where natural barriers like ocean, mountains do not exist. With unprecedented growth of cities, increased urban population and urban migration, the traditional food supplying peri-urban agriculture areas started shrinking. This has resulted in increasing the food miles and ecological footprint.

Urban initiatives vary substantially from place to place. In recent times, in some cities, they have increased considerably as citizens started becoming health and environment conscious. Enthusiastic farming communities got interested to pick up new skills to grow food organically. This created new groups of enterpreneurs supporting such initiatives in terms of the new materials and media for plant growth, waste recycling for manure and efficient use of limited spaces available and use of vertical gardens. Also, there have been efforts made by several agencies including civil societies to revive peri urban agriculture pockets around cities/towns. Also, covid pandemic also created new producer groups as well as markets, through producer consumer linkages. New groups of enthusiastic and innovative people getting interested in farming are investing and cultivating organically in the outskirts of the cities.

In this issue we would like to include such urban and peri urban initiatives. We look forward to experiences of citizens, associations, development agencies including the process and scale of such initiatives. It could be about the forward backward linkages too with regard to alternative media, reusable media and materials. Also, it would be interesting to know the enabling environment in terms of policies and challenges faced and multistakeholder involvements in your city or around the city.

We invite articles for the March 2022 issue of LEISA India. Kindly send your experiences to the editor at leisiaindia@yahoo.co.in before 31st January 2022.

A journey towards integrating dairy

Archana Bhatt, Raveendran and Abdulla Habeeb

While adversity inspired her to start a new initiative, the training and the support she received from external agencies made her dream possible and sustain. Lily Mathews is a case to draw inspiration in converting an adversity into an opportunity. Completing 25 years in dairy farming, she is now a role model to reckon with in the region.

Lilly Mathews, a successful dairy entrepreneur

Lilly Mathews, is one among very few women who dared to take up new challenges in their life when the things went down. When her family suffered severe loss in agriculture, she took up an initiative to try her hand in dairy farming as a coping strategy for the loss incurred in pepper farming. Lilly Mathews is a passionate women farmer who is now owner of more than 70 productive cross bred cows and running a successful dairy venture from her home in Mananthavady, Wayanad, Kerala. But this journey was not an easy one to achieve, but she took the challenge and managed the risk involved with setting up her dairy enterprise.

In the past, Lilly and her family was predominantly engaged in the cultivation of black pepper in nine acres of land along with other crops like coconut, coffee, areca nut, cashew nut and vegetables. Their main source of income was through pepper and they used to receive 40 qtl of pepper. Coconut, coffee and areca nut also contributed significantly to their income. But nearly 26 years ago, a sizable portion of the pepper perished owing to diseases like quick wilt and slow wilt and it became very difficult to revive these pepper vines. Currently, they are still cultivating pepper varieties, mainly Karimunda and Panniyur-I while Wayanadan was completely gone

due to disease infection. It was a tough time for the family as they faced immense financial burden since apart from pepper, areca nut also got affected by diseases and couldn't survive well. In these vulnerable times, Lilly Mathews didn't lose hope and with support of her family, decided to start off a dairy venture as a coping strategy. Her parents were traditionally rearing dairy animals so this experience gave her the courage to take up this enterprise.

Dairy initiative

Initially, Lilly Mathews started with a small dairy unit of 15 cross bred cows that she brought from Coimbatore and the rest is history. Her husband, Mr. Mathews was a lecturer in a private college at Mananthavady; later he also joined with her in dairy farming. Due to the disease infection in the pepper crop, they cut down few trees that were used as a support for pepper and started fodder grass cultivation. Even though, she had experience in dairy farming, starting dairy as an enterprise was an entirely new challenge. Lilly attended various trainings to equip herself as a full fledged dairy farmer. She also got support from government departments and other organizations in her journey. In 2008, she received support for 10 cows from the Animal Husbandry Department followed by support for buying the milking machine, planting of fodder grass as well as elaborating the cow shed. Later in 2014, she received training on cattle rearing and development of milk products from Erode Animal Hospital and Veterinary College, Pookode. All these trainings helped her gain more confidence and inspired her to follow her passion in dairy farming.

At present, her farm is home to 70 cross bred cows. Since last 10 years, milking is done through automated milking machines with the help of few workers who are also fairly trained in dairy management by Lilly herself. All the cows are fed with quality feed and good fodder cultivated on her farm along with mixed ration that she herself prepares in definite ratio via various concentrate and feeds. She also shared that in case of any necessity, the officials from Animal Husbandry Department

Cows are fed with quality feed and good fodder cultivated on the farm

provide her the needed support for immediate medical emergency.

In 2018, Lilly achieved a new milestone. She initiated a Value Addition Unit at her home with a cold storage facility to produce diverse products from milk including curd, ghee, butter, paneer, butter milk, etc. Earlier, she was getting a minimum Rs.35 per liter milk while selling at the Milk Society, but after the value addition unit was installed she got an amount of Rs.55 per liter. This helped her achieve a fairly better income every month through the sale of milk and milk products. Currently, her farm produces around 700 litres of milk per day. She says that minimum 20 liters of milk per cow is essential to run the farm successfully and profitably and below this range can incur losses due to high expenditure. She is marketing milk and milk products across Wayanad and Kannur districts with her own brand "Lillys" through their transport vehicles and two shops. Neighbours and visitors who come to visit the farm can also buy the products directly from the unit. Apart from cattle, she also maintains poultry, flying duck, goose, etc., and planning to rear some goats as well, in near future.

Farm level integration

With the success of her dairy farm, Lilly revived her love for crop farming as well. Apart from coffee, pepper, coconut, etc., she is cultivating various vegetable crops also. Entire farm is solely run organically. Cow dung slurry (Cow dung + cow urine) is collected and utilized as organic fertilizer for the entire farm and bio gas plant is also under progress, to recycle the dung. Cow urine is also used for pest management and sold as per demand. She is planning to start another venture on production of organic fertilizers like Jeevamrutam in coming years. She has now started reviving the pepper she lost in the yesteryears along with expanding her enterprise to value added products.

As she is ready to celebrate the silver jubilee of her farm next year, she proudly tells that her dream is to increase her farm's milk production to 1000 liters per day by increasing the number of cows to 90. Her advice to the new comers in this field is to initiate the venture at a small scale. And, one should receive proper training and start steadily in achieving their goal. With her success, Lilly Mathews is now a recognized resource person for fellow farmers and students who visit her farm for advice. She has received numerous accolades at national and state level including Dairy Woman of the year at various occasions for her achievements. She also serves as a prominent speaker in Radio Mattoli at Dwarka, Mananthavady to share her knowledge and experiences.

A value addition unit at home to produce diverse products from milk

Reminiscing her past, Lilly shares how she turned her life around from experiencing severe debt to getting a good house and a successful business by integrating dairy in her conventional farming system. Her journey is an excellent example of how livestock when integrated into a traditional farming system can change the dynamics of a crop based agricultural system.

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Traversing through the traditional agro-pastoral systems in India

Rituja Mitra and Sahith Goverdhanam

The interlinkages between pastoralism and agriculture have the potential to play a key role in transitioning to a green, environmentally sustainable and global economy. Examples of pastoral systems across the country provide an understanding of their knowledge systems in the management of natural resources, adapting toward local climatic conditions, and the economic and ecological value created from the livestock manure in enhancing soil fertility.

Agro-pastoral systems across India through time immemorial have shown their interconnectedness with ecology, the livestock breed emerged as a subsistence form of economic arrangement. The nomadic pastoralists across the country have intertwined with the farmers for sustaining the agricultural as well as the traditional pastoral occupation. The herder and farmer's mutual relationship has evolved to benefit the local economy, the livelihood opportunities for the farmers and the pastoralists and is environmentally sustainable.

Scenarios of the Mutual Relationship

The spatial and temporal availability of grazing resources coupled with erratic weather events has pushed in for mobility amongst pastoralists across the country. The transhumance form of pastoralism as practiced in several Indian states has shown a reciprocal relationship with the farmers. However, over the years the practice has been fading off due to commercialization of agriculture across the country.

Bharwad women busy cleaning the cotton farmlands, while herds are busy rearing

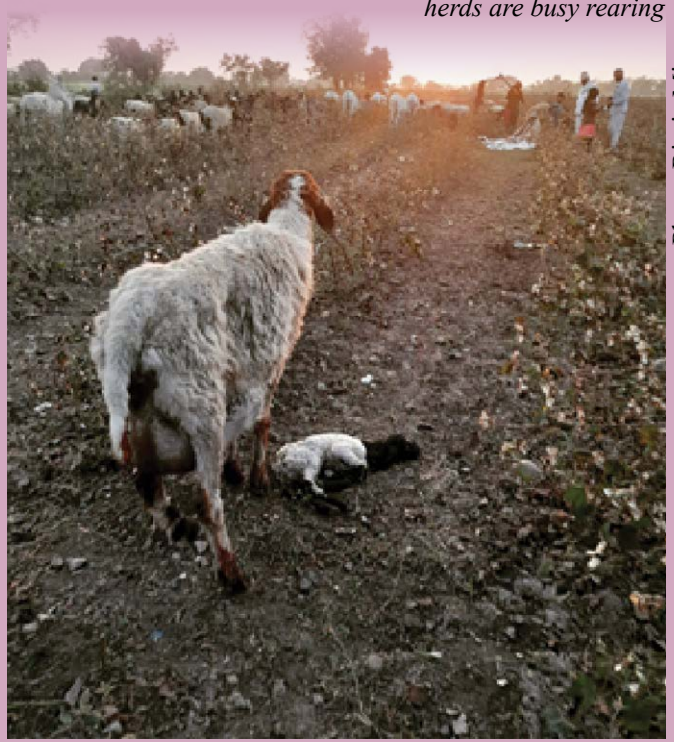

Photo: Rituja Mitra

Sharing a Common Bond: Anecdotes from Western India

In Gujarat's Saurashtra region the pastoralists locally known as *Maldharis*- Bharwads, Rabaris travel to different parts of the state in search of fodder to sustain their livestock, enroute to the grazing resources they are also dependent on the farmer's land for fodder. Raja Bhai, 37, a goat and Halari donkey breeder travels from his native village in Khambhaliya Block, Dev Bhumi Dwarka to Upleta block, Rajkot after Diwali. He explains, *"Mostly when Kharif cropping season ends, the farmers require labourers to clean the farms after the cotton is harvested, while our livestock requires fodder. We therefore have this agreement with the farmers that we clean the land and provide them fallow land to start with the new cropping season".*

Bhupat Bhai Boondiya another Maldhari from Rajpara Village of Dwarika travels around 200 kms from October end to June. He explains the economics behind the relationship - *"Usually any labour to clean farm off the cotton plants charges Rs 350 per day and works for 5 hours each day. Any farmer owning at least 5 acres of land incurs around Rs 3500 with 10 days of efforts to clean and prepare the farm ready for the next season. Our goats and sheep graze all day long. Women members of our family bundle up the plant once it grazes and we charge nothing for this".*

Not only does the migratory pastoral community understand the importance and need for such a relationship to sustain economically; they do understand the bond will help to maintain a cultural relationship which is viable for the environment. Bhima Bhai, a farmer near Seth Vadala village, Jamnagar asserts, *"I allow 5 such Maldhari families to stay in my farmland, and this has always been pursued by my family".* He comments that this land belongs to everyone using a phrase- " *Aa zameen Gopal ki*" [The land belongs to Lord Krishna]. Bhima Bhai adds that not only do the goats and sheep graze the farms but they provide manure to help in sustaining the value of the soil. He further explains that the Maldhari members provide them goat milk as and when required by the farmers.

> The unique bond of farmers and pastoral communities requires much recognition than ever before.

Photo: Rituja Mitra

A Bharwad allowing his sheep to graze in Cotton farm lands in Upleta Taluka, Jamnagar

A case of trust from Andhra Pradesh

Such examples of mutual trusts were also shared by the farmers of Raptadu mandal of Anantapur district of Andhra Pradesh. Most of the sheep rearers from the Kurumas community, visit the farmer's land in search of fodder. In lieu, the farmers provide them food, shelter and offer clothes. Such visits and stays in the farmer's land are usually celebrated by the farmers like another festival, where they prepare *Korralu* [Foxtail] payasam which is offered to the pastorals on one of the days. In places like Anantapur which are subjected to extreme climatic conditions, such relationships not only secure the small farm holders but secure the livelihood of pastoralism as an occupation.

Narratives from the Himalayas

Jaunsar-Bawar's pastoralists traverse vertically in search of summer and winter pastures for their livestock, displaying a unique bond not only with the farmers but also with the artisans of the regions. The Khas pastoralists of Jaunsar-Bawar of the Western Himalayan state of Uttarakhand are mostly rearers of sheep and goats. They are dependent on apple and apricot orchards

during the harvesting season of September-October. Often these rearers travel to farmer's land and would allow the livestock to graze. While on the land, they shear the animals as well, in order to prepare for the winters. Meanwhile, the Khas (Pastoralists) keep some of the sheared wool, while giving some to the Koltas (Artisans) to make garments for their personal use and also to sell in the market.

Puran Singh Chauhan, a local resident of Gorchha village in Jaunsar adds, *"One or two members of each family here are still into pastoralism. But, with an increase in cash-based economy and Dehradun- Vikasnagar growing, most of the youth have shifted to the towns and the current occupation is dwindling like never before"*. He reminisces that the system has not only gone down for the pastoralists and farmers but even the traditional pastoral products like *Chaura* [overcoat from sheep wool], *Khursa* [warm shoes from goat wool], *Kharsa* [mat from goat wool] are no longer in use.

Photo: Sahith

Enroute to Farmer's Field, Anantapur

Such changes have undermined the traditional culture around agriculture which was much more closely synchronized with the local ecosystem. Farmers in the terrain are now finding it difficult to find organic manure and are forced to apply chemical fertilizers in their farms and orchards. This is causing long-term damage to the fragile Himalayan ecosystem of the region.

Need for Recognition and Linkages

As we see the momentum towards natural farming has increased in a few states, linking the pastoral communities with the farmers will benefit both economically and environmentally. The linkage can help the farmers access

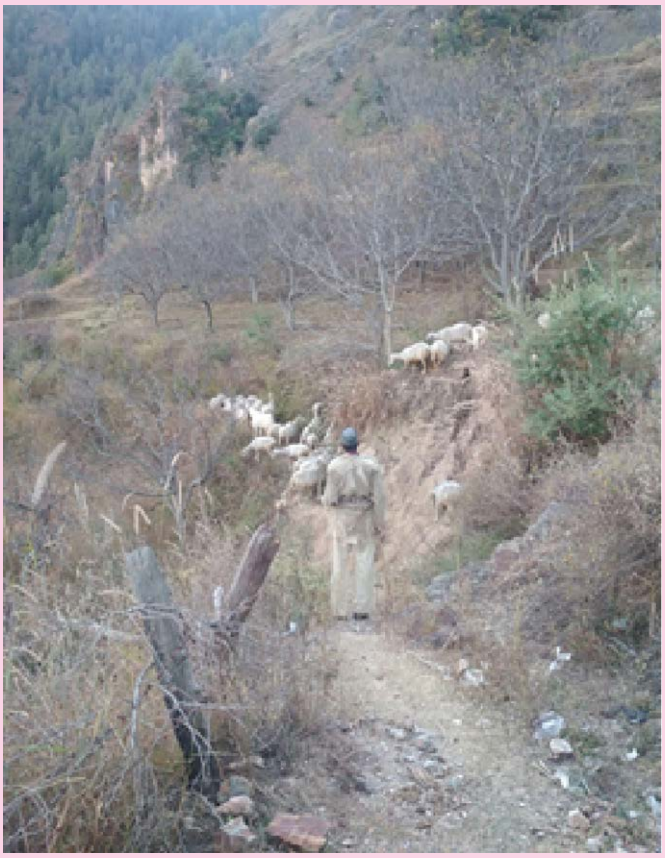

Photo: Rituja Mitra

A Pastoralist with his herd in Apple Orchard, Jaunsar

organic manure at a local level and also supplement the income of pastoralists with the exchange of manure with farmers. These examples of pastoral systems across the country provide an understanding of their knowledge systems in the management of natural resources, adapting toward local climatic conditions, and the economic and ecological value created from the livestock manure in enhancing soil fertility. The interlinkages between pastoralism and agriculture have the potential to play a key role in transitioning to a green, environmentally sustainable and global economy. There is a need to develop systems and policies that can strengthen the pastoral community who are always on the thin line of vulnerability and with extreme uncertainty.

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Cactus – An emerging fodder alternative

I.I.Hugar

Spineless Cactus with its high succulency is emerging as one of the promising fodder options for livestock. With its high water use efficiency, cactus serves as an excellent fodder species, especially under water stressed conditions. BAIF in Karnataka is successfully promoting cactus as livestock fodder among farmers in South Indian States.

Spineless Cactus can survive in degraded soils

In India, around 53% of land is having dry and semi dry regions. Climate change impact is already observed in several places, particularly in dry and semi dry regions, destroying crops, animals and livelihoods. Farmers have been struggling in not only accessing food but also feed for the livestock.

The arid and semiarid areas are characterized by limited resources. Production of green fodder is rare, particularly during the hot and dry season (summer) when the animal feed is strongly complemented by feeding concentrates. During summer period, farmers face green fodder scarcity and animals need green fodder with more water content. In such a situation, spineless cactus cultivation is boon to the farmers. In India, however, cactus is not yet grown as a commercial crop.

To face these critical periods, the spineless cactus which is useful for ground conservation and reduction of streaming, has emerged as an alternative feed for livestock. Spineless cactus which is being widely cultivated to combat desertification and reclaim degradation, could be used as green fodder in all seasons.

Spinless cactus is the best alternative to green fodder, especially in summer period as it consists of 80 -85% water content. Cactus is an alternative source of green fodder during scarcity period. It can be grown in soils where no other crops can grow. Cactus is not only used as fodder. It is also used as a medicine. It is an excellent source of water too for livestock as it contains 85-90% of water, besides being rich in vitamins, carbohydrates proteins (5-9%), calcium, potassium and other minerals.

The Initiative

BAIF Gramodaya campus, Tiptur, Karnataka, initiated spineless cactus cultivation and promotion with 4 accessions under research, demonstration and training purpose, besides maintenance of germ plasm during 2018-19. BAIF has been promoting spineless cactus on farm bunds and uncultivable lands so that regular cropping area is not disturbed.

From 2019-20 onwards a number of farmers, NGOs, Govt staff, School students, SHGs and Artificial inseminators from different districts and States, have visited the demoplots and have been exposed to cactus cultivation and feeding methods. Around 120 farmers from Chitradurga, 220 farmers from Sira, 110 Artificial inseminators from Mysore, Belgaum, Dharwad, Gadag, Bagalkot, Hassan, Tumkur districts in Karnataka; 65 farmers from Tamil Nadu; 180 farmers from AP and 150 farmers and vet practitioners from Telangana and Tiptur were trained on promotion of spineless cactus. Most of these farmers who visited and got to know about the importance of cactus as livestock feed collected cladodes and planted them on the field bunds and available spaces. Each farmer planted around 10-15 cladodes on an average.

As spineless cactus is an arid crop, it does not require frequent irrigation. However, a limited irrigation of once a month can increase the growth and productivity of

Box 1: Method of cultivating Cactus

Planting cactus during post rainy season, starting from October to March, is best time for successful establishment and survival. Fresh cactus cladodes (Flattened leaves of 6-15 inches width) have to planted after reducing its water content to 65 to 70%. The cladodes from mother plant are separated and kept for 4 to 5 days under shade, to reduce the moisture content. Raised beds of 2 feet width and 1 feet height and convenient length should be prepared for planting cactus.

Do not water the plants immediately after the planting. After a week's time, water the plant lightly (1liter/pot). Subsequent watering may be provided at 10 days interval.

The average of 15-30 cladodes per plant was recorded at 12 months after planting. The biomass harvesting in cactus should be initiated after one year of the planting keeping the basal cladodes. The other cladodes may be harvested by cutting with sharp knife and fed to the cattle. Cactus plant should attain a height of 1 mtr preferably, at the time of first harvest.

Cactus is an excellent source of water too for livestock as it contains 85-90% of water, besides being rich in vitamins, carbohydrates, proteins, calcium, potassium and other minerals.

cactus cladodes. It can survive in degraded soils, provided the soils are not so saline that it inhibits the growth of the cactus. Therefore, it can be used for reclamation of degraded soils. The PoP of cactus cultivation is one of the simplest among all fodder crops (Box 1). It requires minimum input and very easy to propagate. It is highly drought tolerant and can withstand high temperature throughout the year. Therefore, cactus needs no such maintenance, hence farmers are happy to have cladodes on field bunds or wherever space is available. It acts as live fencing, wind breaker and green fodder to their livestock.

This spineless cactus can yield up to 20T/ hac with minimum care and management and provide feed to 5-6 cattles for one year. One could feed 10 kg cactus (8-10 cladodes) per adult cattle per day (each cladode weighs about 0.800 to 1.200 kg) It is rich in minerals. Well developed cladodes are chopped into small pieces and mixed with dry fodder and fed to cattle and goats. It has high fiber content so it may be fed in summer season

Farmers in Andhra Pradesh and Telangana have started feeding their animals and small ruminants with cactus. Around 23 farmers in Chitradurga district, who planted around 15020 cladodes are eager to feed spinless cactus cladodes to their animals.

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Cactus cladodes are planted on raised beds

Bio-gas production for sustainable agriculture

I took up farming in 1992, at my native village (after retirement) Ammachiyapuram, near Theni District, Tamil Nadu, after my retirement from Tamil Nadu Electricity Board. We started farming with one native cow and calf. Presently we own twenty cattle (cows and bulls). We bred and sold more than hundred native cows and bulls. We have a poultry farm with fifty birds. Our farm is surrounded by 300 hundred coconut trees.

We use bio gas for our cooking. We started our first bio gas plant in 1990 with a rotating drum model (drum holder made of steel). We could not run the bio gas plant as we did not own the cows, then. We started our second plant in 1994 and it was a rotating drum model (holder drum made of plastic). We could not run the plant as the plastic drum got jammed inside the holder and the drum got damaged.

After failures we decided to go for other type of models. We constructed dome (Dinapandhu) model bio gas digester. We constructed one digester and after seeing the performance decided to go for two more digesters. Presently we have three bio gas digesters of 2.5 meter cube each. All the inlets for feeding cow dung (into the digester) is interconnected by PVC pipe and valves are provided at each plant inlet. Inter connection of inlets minimizes labour and saves time for feeding cow dung. For mixing the cow dung with water, cements tubs are provided and tub is connected with water tap. Daily cow dung is loaded to the tub and mixed with water and fed through the PVC pipes at once. These three plants can provide bio gas 24 hours a day. The biogas digesters are running for more than ten years now.

The outlet of bio gas digester is taken through tubes (tubes are taken to 10 meter height before using in stoves to reduce the moisture droplets in the gas). Bio gas is one of the best methods for sustainable agriculture. It is said that 2-3 cows are enough for running one 2.5 meter cube bio gas digester. We have a portable digester in house which I am testing for its performance. I being an electrical engineer my main aim is to produce electricity from biogas. We also purchased a diesel motor and diesel generator for doing experiments with biogas. We tried to purchase a generator running with biogas from an IIT Professor who is working on biogas. We could not purchase the bio gas generator as it was costing us around 1.25 lakhs.

The bio gas digesters supply good manure for fields. The outlet of the plant is connected to the canal. The digester outlet canal is provided with pump set water which carries the digester cow dung to the fields. This reduces the labour for transport of digested cow dung to the fields. The digesters are built at high level from ground so that water and cow dung from digester easily flows into the fields. The insects which are generated by cow dung are good feed for hens and ducks.

We own more than 300 coconut trees. We own our own oil extractor and rice huller. We also sell coconut oil, rice and other cereals to farmers in our village. We also produce our own cattle feed. Presently, we are using the rice husk and oil cake as a feed for cattle and poultry. Around 5-6 labourers work on the farm and my son Rajaseelan takes care of the farm. Being a well known organic farmer in Theni district, many farmers visit our farm daily for innovative approaches and advice.

I feel bio gas digester is one of best options for sustainable agriculture if a farmer has cattle and water availability and is prepared to invest in a small way. With LPG getting expensive, bio gas digester is the best option for any organic farmer which also helps in promoting sustainable agriculture.

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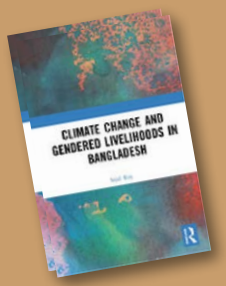
NEW BOOKS

Orphan Crops for Sustainable Food and Nutrition Security Promoting Neglected and Underutilized Species

Stefano Padulosi, E.D. Israel Oliver King, Danny Hunter, M.S. Swaminathan (Eds), *2021, Routledge*, 470 p., ISBN 9780367902827

Orphan Crops for Sustainable Food and Nutrition Security discusses the issues, challenges, needs and opportunities related to the promotion of orphan crops, known also as neglected and underutilized species (NUS).

Presenting a number of case studies at the regional and country levels, the chapters cover different but highly interlinked aspects along the value chains, from acquisition and characterization of genetic diversity, cultivation and harvesting to value addition, marketing, consumption and policy for mainstreaming. Cross-cutting issues like gender, capacity building and empowerment of vulnerable groups are also addressed by authors. Representatives from communities, research for development agencies and the private sector also share their reflections on the needs for the use enhancement of NUS from their own perspectives.



Climate Change and Gendered Livelihoods in Bangladesh

Sajal Roy, *2021, Routledge*, 272 p., eBook-£33.29, ISBN 9781032003023

Globally climate-induced disasters have been impacting marginalised communities' lives, livelihood and gendered relations. This book explores the effects of Cyclone Aila (as a result of climate change) in 2009 on the rural livelihoods and gendered relations of two ethnically distinct forest communities – Munda, an indigenous group, and Shora, a Muslim group – dwelling near the Sundarbans Forest in Bangladesh.

This book addresses a gap in current critical development studies. It adopts an ethnographic research design and analyses the alterations to livelihood activities and reconfiguration of gender relations within the Munda and Shora communities since 2009. The study primarily contends that post-Aila, livelihoods and gendered relations have been substantially transformed in both communities, making the case that the improvement of local infrastructure, as an important part of the geographical location, has noticeably progressed the living conditions and livelihoods of some members of the Munda and Shora communities.

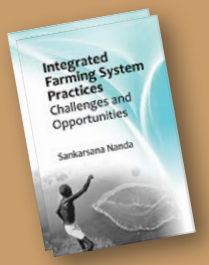
Ecological Intensification of Natural Resources for Sustainable Agriculture

Manoj Kumar Jhariya, Ram Swaroop Meena, Arnab Banerjee (Eds.), *2021, Springer*, 720 p., Hard Cover – Rs.18459, ISBN-13 : 978-9813342026

The concept of ecological intensification presents the mechanisms of ensuring high agricultural productivity by restoration the soil health and landscape ecosystem services. The approach involves the replacement of anthropogenic inputs with eco-friendly and sustainable alternates. Effective ecological intensification requires an understanding of ecosystems services, ecosystem's components, and flow of resources in the agroecosystems. Also, awareness of land use patterns, socio-economic factors, and needs of the farmer community plays a crucial role. It is therefore essential to understand the interaction of ecosystem constituents within the extensive agricultural landscape.

Drawing upon research and examples from around the world, the book is offering an up-to-date account, and insight into the approaches that can be put in practice for poly-cropping systems and landscape-scale management to increase the stability of agricultural production systems to achieve 'Ecological resilience'. It further discusses the role of farmer communities and the importance of their awareness about the issues.

SOURCES

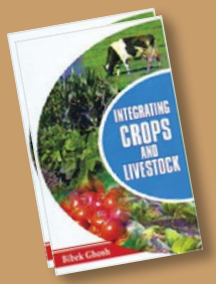


Integrated Farming System Practices: Challenges And Opportunities

Sankarsana Nanda, 2016, NIPA, 563 p., ISBN 9789385516207

The adoption of integrated farming systems involving lower external inputs, residue recycling and organic practices can alleviate economic and ecological problems. Alternatives to energy-based inputs, crop rotations, inter-cropping, use of organic matter, integrated crop, fertilizer, pests and weed management practices certainly impose larger dividends to farm income and employment. Besides this high-tech horticulture, pisciculture, dairy, poultry, mushroom culture, apiary and agroforestry can be made component of Integrated Farming Systems. It is essential to integrate the components of agricultural systems fully so that the impacts of other inputs will be visible.

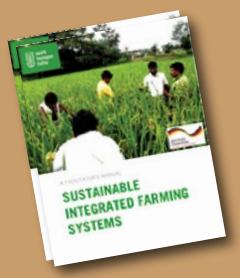
This book focuses on different practices of Integrated Farming System in eastern-India and for scaling up the technology for community need. It provides a detailed account of principles, challenges and opportunities in simpler yet compact manner for better understanding of the researchers and policy makers.



Integrating Crops and Livestocks

Bibek Ghosh, 2007, Gene-Tech Books, 297 p., ISBN 13: ‍978-8189729769

Integrated farming utilises cropping patterns which involve the raising of crops, animals, and or trees. A labour intensive integrated farming practice includes crops, duck, fish etc. on small-holdings, based on maximum recycling principles. With appropriate crop combinations and proper agronomic practices, integrated farming will not only increase grain yields and ensure economic returns, but it will also make available sufficient livestock feed and maintain soil health. This book discusses the modern trends in integrated farming and describes technologies for mixed farming systems and identifies major constraints. It is designed for students of agriculture, farmers and decision-makers concerned with agriculture and rural development.



SUSTAINABLE INTEGRATED FARMING SYSTEMS

A Facilitators Manual

Welthungerhilfe, 2021, Welthungerhilfe South Asia Regional Office, 72 p

This manual is an outcome of the “Sustainable Integrated Farming System Program” which is implemented in three countries (Bangladesh, India and Nepal) since 2011 by six national NGOs in cooperation with Welthungerhilfe. This manual is a contribution to bring back a genuine interest in skill building for small-holders by facilitating an intensive and systematic process to bring more diversity to the farms, as well as integrate and improve production processes. We believe that farming, including smallholder farming, is not only a traditional lifestyle or livelihood, but also a profession and a business, which can be viable. To maximise the benefits from small-farming, civil society, the private sector and Governments need to step up efforts to provide effective extension and skill building. In this sense, this manual can provide a model for larger interventions. This manual is still work in progress. It has been field-tested for its efficiency related to the sessions and the learning outcomes; the processes have proven to be effective as well – as indicated in a number of case studies and data analysis of our program.

Farm integration returns more

J Krishnan

Integrated Farming Systems (IFS) involves linking several components of the farm system. Resource flows are established between components. The 'outputs' from one component serve as 'inputs' for another. IFS approach is the way forward for resource optimization, utilization; sustaining and improving farm productivity and farm livelihoods; cultivating nutritious, healthy and diverse food and animal feed, besides meeting other rural needs.

Kodiyalli is a village located nearby the reserve forest range of Pennagaram block in Dharmapuri district, Tamil Nadu. The village is surrounded by reserve forest. Majority of the farmers are small farmers and rain fed farmers, threatened by vagaries of weather. For livelihoods, they are dependent on seasonal dry land monocropping systems. They have to deal with depleted soil fertility, expensive and risky chemical inputs for pest management. The farms are generally managed by women as men migrate to urban areas. Many of them struggle to deal with pest incidences, reduced fertility of soils and risks involved in monocropping with errant climate.

Crop harvests serve as fodder for animals

To help farmers switch over to ecological options, thereby reduce costs of cultivation and enhance yields, AME Foundation has been working with farmers of Kodiyalli since early 2021. The farming communities are trained systematically with intensive field guidance to try out acceptable and affordable alternatives for natural resource management and integrated farming systems.Thamilarasi, aged 27, is one such farmer who participated with enthusiasm in those learning processes.

Thamilarasi was cultivating either Groundnut or Ragi as single crop in one acre dry land. She owned two cows fed regularly with expensive and purchased green and dry fodder and concentrates. With training and guidance from AMEF, Thamilarasi was motivated to try out Integrated Farming system model on her farm land. Also, she was keen to add additional components like kitchen gardens, azolla and mushroom on her farm.

Moving over to mixed cropping

Initially, Thamilarasi decided to move from monocropping to multiple cropping based on food, fodder and income requirements of her family. She was prepared to try out ecological approaches. The crop combinations like deep rooted and shallow rooted; cereals and pulses were identified to meet multiple requirements. For instance, access to diverse foods, feed sources for livestock, for improving soils and microclimate, enabling enhanced stubble yield, addressing pest and diseases through ecological means like promoting 'predators' to control 'pests'. Further, for preparation of organic manures, the plant and animal 'wastes' were identified.

Groundnut was intercropped with red gram for family's year long requirement, castor grown as trap crop to protect groundnut from insects (larval stage) attack, the cow pea on inside border as major source of pulses, the sorghum/cumbu on outside border as preventive measure to stop sucking pests entry, attract predators besides yielding food grains and fodder. While half an acre of land area allotted was for groundnut cultivation, ragi was cultivated in the other half which lab lab and Red gram crops were intercropped.

In an area of 0.5 acres, **fodder crops** were established which included perennial fodder grass like Co4CN sweet sudan, CoFs 29 multicut sorghum, desmanthes etc.. to create fodder support within 3-4 months period.

Recycling crop and animal wastes

Thamilarasi never reused the crop and animal wastes earlier. They were left indiscriminately all over the farm (over a period of 10-11 months), getting exposed to sun and rain– resulting in improper decomposition, thus not helping in soil fertility enhancement.

But now she learnt and started preparing organic manure using the crop and animal wastes. A pit with a dimension of10x15 feet was prepared. It was divided into two parts. One part was meant to keep the cow dung safely under decomposition process and another one for the crop harvest residues, stubbles and other plant manurial biomass sources. On a daily basis, each part is filled. Also, the cow dung solution is added after (1-2feet) layer of biomass fill.

With farmer rearing 5 birds as part of backyard poultry and two goats, the compost pit was filled further with their droppings too. On an average, the daily animal wastes amounted to 25 kgs of cow dung from 2 cows, 600 gm of poultry waste from 5 poultry birds and 1 kg goat waste from 2 goats. In a short span of time, high quality of manure is produced.

Feed management

Diverse fodder crop harvests like ragi straw (912kgs), haulms of groundnut (476kgs), sorghum straw (122kgs) contributed as green and dry fodder for farm animals. Upon harvest of seasonal crops, the feeds were prepared at home. While sorghum and maize grains served as cereals for energy, the protein source was the groundnut oil cake. Around 47 kgs of ground nut oil cake is obtained from crushing 100kgs of groundnut kernel after oil extraction.Along with ragi and gram husks, around 200 kgs of concentrate feed is prepared.

"I never bothered about proper storage of cow dung and the plant biomass...after understanding, I also use weeds for composting", says Thamilarasi.

Azolla grown on the farm is fed as feed supplement to farm animals

By using crop harvests as fodder and by preparing concentrates, Thamilarasi avoidedbuying green fodder and concentrates. Earlier she spent around Rs. 1650/ per month for purchasing 210 kgs of concentrates and Rs.7500 for purchasing green (sorghum) or dry fodder (paddy straw) of 250 kgs. "*These expenses severely eroded my income. Many times, I felt it as a burden to keep the farm animals with their feed requirements", says Thamilarasi.* Her two cows presently yield around 10 to 15 liters milk, every day. The monthly income by selling milk was on an average Rs.16,500 to 20000.

IFS – Multiple benefits

In 2019-20, from half an acre, Thamilarasi harvested only 280 kgs of groundnut and 670 kgs of ragi, realising an income of Rs. 30,000 to 35,000/acre. But in the year 2021-2022, she could harvest an array of crops, besides main crops like groundnut (436kgs/0.5acre) and Ragi (920kgs/0.5acre) which fetched her an income of Rs. 44,560.

From the kitchen gardens established in backyard, within a period of 3 months, she could harvest on an average 1.5 kg chilies, 3 kgs tomato, 3kgsbhendi, 2kg lab lab, 25 kgs bottle gourd, 20 kgs ridge gourd,10kgs bitter gourd, 2.5 kgs brinjal, 4 types of greens, 10 kgs cluster beans and 25 kgs pumpkin. By avoiding outside vegetable purchase, Thamilarasi could save around Rs.4500/- from September to November 2021 on buying vegetables, besides having access to healthy food. Also, the vegetable wastes are fed to animals and filled in compost pit.

Besides dairy, three more components in farming system improved her incomes as well as manurial sources - backyard poultry, goats and azolla. The goats are valued at Rs.16000, the poultry yielded around 40 eggs and the hatched out 35 young birds are weighing 250gms each as on December 2021. As birds gain weight, improved returns are expected – around Rs. 28,000.00. She also has started cultivating azolla by November in the back yard. She has started harvesting 0.5 to 1kg every alternate day from 12 sq.meter area. Azolla is fed as feed supplement to farm animals.

All these linkages and integration has helped Thamilarasi realise an estimated income plus savings of around Rs. 1,00,560/- from her farm. Besides increased income, through IFS, Thamilarasi could get nutritious food, follow ecological pest control and got access to home made feed for livestock by recycling plant and animal wastes. Moreover, all these additional enterprises kept her engaged on the farm for a longer period. She says, "*I feel proud that I have my own farm work".*

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